

REMARKS

Claims 1-14 and 16-27 are pending in the present application. In the Office Action dated December 1, 2004 the Examiner rejected claims 1-2 and 11 under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,278,114 issued to Mitsui. Claims 20-24 and 26 were rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,747,816 issued to Kurosaki. Claims 12-14 and 16-19 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,834,783 issued to Muraki et al. and in view of U.S. Patent No. 4,600,839 issued to Ichihashi et al. Claims 25 and 27 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,747,816 issued to Kurosaki.

The disclosed embodiments of the present application will now be discussed in comparison to the cited references. Of course, the discussion of the disclosed embodiments, and the discussion of the differences between the disclosed embodiments and the cited references, do not define the scope or interpretation of any of the claims. Instead, such discussed differences merely help the Examiner appreciate important claim distinction discussed thereafter.

In one embodiment shown in Figure 5, an apparatus for measuring the dimensions of semiconductor features includes an electron gun 230 positioned above a stage 240 that supports a semiconductor substrate 20 being measured. The apparatus further includes a condenser lens 231 and a port surface 232 that comprises a first port 232a and a second port 232b. Electrons emitted from the electron gun 230 pass through the condenser lens 231 and through the first port 232a and second port 232b. By passing through the first port 232a and second port 232b, two electron beams 235a and 235b are formed, wherein each respective electron beam 235a and 235b then passes through a corresponding condenser lens 233a and 233b to be focused on the semiconductor substrate 20. In operation, each of the electron beams 235a and 235b may have a different depth of focus. In another embodiment, one of the ports 232a and 232b may be blocked and the semiconductor substrate 20 scanned by only one electron beam at a time. The other port may be unblocked and the semiconductor substrate 20 may scanned by the other electron beam. In another embodiment, the semiconductor substrate 20 may be scanned by both electron beams 235a and 235b simultaneously to advantageously reduce the scan time.

In another embodiment shown in Figure 6, an apparatus for measuring the dimensions of semiconductor features includes two electron guns 330a and 330b positioned above a stage 340 that supports a semiconductor substrate 20 being measured. Electrons emitted

from the electron guns 330*a* and 330*b* form electron beams 335*a* and 335*b* which pass through a corresponding condenser lens 331*a* and 331*b*. The ports 332*a* and 332*b* in a port surface 332 receive the corresponding electron beams 335*a* and 335*b* from the condenser lens 331. Upon passing through the port surface 332, each electron beam 335*a* and 335*b* passes through a corresponding objective lens 333*a* and 333*b* to focus the electron beams on the surface of the semiconductor substrate 20. In operation, each electron gun 330 may be individually controlled and the corresponding depth of focus of the electron beams 335*a* and 335*b* may be controlled by their respective condenser lens 331 and objective 333.

In either embodiment, in operation, a feature of a semiconductor substrate may be scanned by an electron beam having a first depth of focus to create a first reflected electron beam and by a second electron beam having a second depth of focus. By focusing the first electron beam on one portion of the feature and the second electron beam on another portion of the feature, the various dimensions of the feature may be measured by detectors detecting the reflected or emitted electrons from the semiconductor substrate 20.

The Mitsui reference cited by the Examiner is directed toward an electron microscope for measuring a dimension of a feature of specimen.

The Muraki reference, which was also cited in the Office Action, is directed to electron exposure apparatus for exposing semiconductor wafers. The apparatuses disclosed in the Muraki reference are used for forming images on the semiconductor wafers. These types of apparatuses are employed in electron beam lithography for exposing patterns on a resist disposed on a semiconductor wafer. The Muraki reference does not disclose or fairly suggest employing any type of detector for detecting electrons reflected or emitted from the semiconductor wafer that the images are formed on.

The Examiner has also cited the Ichihashi reference, which is directed to a scanning electron beam system for measuring small dimensioned features of a sample. Referring to Figure 2 of the Ichihashi reference, the small-dimension measurement system comprises an electron optical column 11, an electron gun 12 configured to emit an electron beam 13, a deflector 14 for deflecting the electron beam 13, and an electron lens 15 for focusing the deflected electron beam 13. The system also includes detectors 19 and 20, such as photomultipliers or SSDs, which are disposed symmetrically with respect to the electro-optical axis for detecting electrons emitted or reflected by the sample 16. Of particular importance is the

fact that the Ichihashi reference is directed toward a measurement system which would require detecting electrons and is not directed towards an electron beam lithography system.

Applicants again submit that there is no motivation or suggestion to combine the teachings of the electron beam lithography system of the Muraki reference with the detectors disclosed in the Ichihashi reference. It is not apparent from the Muraki reference and the Ichihashi reference why one of ordinary skill in the art would modify the electron beam lithography system of the Muraki reference to include a detector that detects reflected or emitted electrons from a semiconductor device. In order to determine the position of the substrate being exposed, the Muraki reference employs a laser interferometer. It is not apparent to the Applicants of what use a detector that detects electrons reflected or emitted from the substrate would serve in the electron beam lithography system of the Muraki reference. In electron beam lithography, electrons are predominately absorbed by the resist on the substrate and any features in the resist are formed after developing the resist after exposure, which normally occurs outside of the electron beam lithography system. Accordingly, there is no need to employ a detector to detect electrons reflected or emitted from the substrate. Assuming *arguendo* that the Ichihashi reference teaches eliminating alignment measurement errors in its small-dimension measurement system, the elimination of the alignment errors is to improve the measurement accuracy of the measurement device disclosed therein. However, no reason has been provided one of ordinary skill in the art would want to measure features on the resist of the substrate being exposed in the Muraki reference.

The Examiner has also cited the Kurosaki reference. The portion of the Kurosaki reference pointed out by the Examiner is best shown in Figure 4 and discloses two electron emitters. Each electron emitter emits electrons that appears to pass through a corresponding port surface (not number in Figure 4). After passing through the corresponding port surface, the electron beam appears to pass through corresponding lenses 55 and 56 and again through corresponding lenses 57 and 58. The Kurosaki reference does not disclose or fairly suggest a system where the beam emitted from the emitter first passes through a lens, then through a port surface, and after passing through the port surface passing through another lens.

Turning now to the claims, the patentably distinct differences between the cited references and the claim language will be specifically pointed out. Claims 12-14 and 16-19 were rejected as being obvious in view the Muraki and Ichihashi reference. Claim 12 recites, in part,

“a first detector spaced apart from the support to receive a first flow of electrons from the semiconductor device and generate a first signal corresponding thereto, and a second detector spaced apart from the support to receive a second flow of electrons from the semiconductor device and generate a second signal corresponding thereto.” As discussed above, Applicant reiterates their argument that one of ordinary skill in the art would not employ a detector that detects a flow of electrons from the semiconductor in the system disclosed in the Muraki reference. Therefore, claim 12 is allowable over the cited references. Claims depending from claim 12 are also allowable due to depending from an allowable base claim and further in view of the additional limitations recited in the dependent claims.

Claim 20 recites “first and second sources of electrons; a first lens positioned proximate to the first source of electrons to receive a first electron beam emitted therefrom; a second lens positioned proximate to the second source of electrons to receive a second electron beam emitted therefrom; a port surface having a first port and a second port therethrough, the first port spaced apart from the first lens to receive the first electron beam passing through the first lens, the second port spaced apart from the first port and from the second lens to receive the second electron beam passing through the second lens; a third lens configured to focus the first electron beam on a first position surface and positioned to receive the first electron beam passing through the first port; a fourth lens configured to focus the second electron beam on a second position surface and positioned to receive the second electron beam passing through the second port ; and a support configured to engage the semiconductor device and located to receive the first and the second electron beams, at least one of the support and the sources of electrons being movable relative to each other.” As required by the language of claim 20, the port surface is positioned between the first/second lens and the third/fourth lens. In contrast, the Kurosaki reference discloses that the port surface is positioned between the electron emitter and the lens 55 in the system 41 and the electron emitter and the lens 56 in the system 42. Furthermore, the port surface shown in Figure 4 of the Kurosaki reference does not have a first and second port. Instead, the Kurosaki reference discloses two separate port surfaces defining ports for use with corresponding electron emitters of the systems 41 and 42. Accordingly, claim 20 is not anticipated because the Kurosaki reference fails to disclose each and every element of claim 20. Therefore, claim 20 is allowable over the Kurosaki reference. Claims depending from claim 20 are also allowable due to depending from an

allowable base claim and further in view of the additional limitations recited in the dependent claims.

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

Respectfully submitted,
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